

Chemical Bonding and Reactions

PS-4 The student will demonstrate an understanding of chemical reactions and the classifications, structures, and properties of chemical compounds.

PS-4.8 Summarize evidence (including the evolution of gas; the formation of a precipitate; and/or changes in temperature, color, and/or odor) that a chemical reaction has occurred.

Taxonomy Level: 2.4-B Understand Conceptual Knowledge

Key Concepts:

Chemical reaction

Evidence of a reaction: evolution of a gas, precipitate, energy change

Previous/Future knowledge: Students in the 7th grade compared physical properties of matter (including melting or boiling point, density, and color) to the chemical property of reactivity with a certain substance (including the ability to burn or to rust) (7-5.9); and compared physical changes (including changes in size, shape, and state) to chemical changes that are the result of chemical reactions (including changes in color or temperature and formation of a precipitate or gas) (7-5.10). In Physical Science students will study the various evidences to verify that a chemical reaction takes place.

It is essential for students to

Understand that when a chemical reaction occurs, there is some observable evidence, but evidence that a chemical reaction has occurred should be weighed carefully. Evidence is not proof. It is the combination of evidences that give validation for a chemical or physical change.

- When bubbles form, it may be evidence that a chemical reaction has occurred and that a new gas has been formed.
 - An example of this is adding an active metal such as zinc to a hydrochloric acid solution. Hydrogen gas will evolve (given off as a product of the reaction). This is evidence that a chemical reaction has occurred.
 - Bubbles could also be evidence that boiling, which is a physical change, is occurring.
- When a *precipitate* forms, it could be evidence that an insoluble solid has formed and fallen out of solution. This is a chemical reaction.
 - An example of this is adding a solution of silver nitrate to a solution of sodium chloride, a white precipitate of silver chloride is formed.
 - It could also be true that some of a substance that was dissolved has fallen out of solution because of a change in conditions. This is a physical change.
- In all chemical reactions there is an energy change.
 - When paper burns, heat and light are given off, an exothermic change. This would be evidence that a chemical reaction has occurred.
 - Many physical changes also involve an energy change. For instance, melting is an endothermic change.
- Color change can be an evidence for a chemical change.
 - When iron rusts or when silver tarnishes, it changes color. This is a chemical change.
 - Color change can also be due to physical factors such as a change in the way light is shining on an object or the mixing of different colors of paint. This is not a chemical change.
- An odor being given off is often evidence that a chemical reaction has occurred.
 - When ammonium carbonate is heated the odor of ammonia gas can be detected. This is a chemical reaction.
 - Odor can also occur because molecules are evaporating from the surface of a substance, which is a physical change.

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It is not essential for the student to provide the reasons for the exceptions to the evidence.

(When a gas evolves – is given off in the reaction, the student should reason that this is evidence, not proof, that a chemical reaction has occurred).

Assessment Guidelines:

The objective of this indicator is to summarize the concepts involved in finding evidence of a chemical reaction, therefore, the primary focus of assessment is should be to generalize major points about evidences for chemical and physical changes.

In addition to *summarize*, assessments may require that students

- Infer that reactions occur when certain evidences are presented;
- Exemplify or illustrate chemical reactions;
- Recall evidences that may indicate a chemical reaction has occurred.